UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/635,811	08/05/2003	Jong-Bum Park	51876P362	9765

8791 7590 05/06/2004

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD, SEVENTH FLOOR
LOS ANGELES, CA 90025

EXAMINER
KENNEDY, JENNIFER M

ART UNIT	PAPER NUMBER
2812	

DATE MAILED: 05/06/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/635,811	PARK ET AL.	
	Examiner	Art Unit	
	Jennifer M. Kennedy	2812	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 August 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *05 August 2003* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *8/5/2003*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Drawings

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description:

18. A proposed drawing correction, corrected drawings, or amendment to the specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Objections

Claim 2 is objected to because of the following informalities: The examiner suggests amending claim 2 to replace "wherein at the step (c), a native oxide layer is used" with --wherein in step (c), a native oxide layer is formed-- for grammatical correctness. Appropriate correction is required.

Claim 4 is objected to because of the following informalities: The examiner suggests amending claim 4 to replace "wherein at the step (b)" with --wherein in step (b)-- for grammatical correctness. Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-3 are rejected under 35 U.S.C. 102(b) as being anticipated by Huanga et al. (U.S. Patent No. 5,670,431).

In re claim 1, Huanga et al. discloses the method for fabricating a capacitor of a semiconductor device comprising the steps of:

(a) forming a conductive silicon layer for a bottom electrode (24) on a substrate (10, see column 5, lines 12-20);

(b) nitridating the conductive silicon layer (30, see column 6, lines 9-16, and column 3, lines 5-13);

(c) oxidizing the nitridated conductive silicon layer (34, see column 6, lines 17-30);

(d) forming a silicon nitride layer (36) on a surface of the oxidized layer (see column 6, lines 31-41);

(e) forming a dielectric layer (40) on the silicon nitride layer (see column 6, lines 42-55); and

(f) forming a top electrode (42) on the dielectric layer.

In re claim 2, Huanga et al. disclose the method wherein at the step (c) a native oxide layer (34, see column 6, lines 17-31) is used.

In re claim 3, Huanga et al. disclose the method wherein the native oxide layer is formed in a thickness ranging from about 1 angstrom to about 5 angstroms (see column 6, lines 17-31).

Claims 1-3 and 6-7 are rejected under 35 U.S.C. 102(e) as being anticipated by Weimer (U.S. Patent Appl. 2003/0042526).

In re claim 1, Weimer discloses the method for fabricating a capacitor of a semiconductor device comprising the steps of:

(a) forming a conductive silicon layer (18) for a bottom electrode on a substrate;

(b) nitridating the conductive silicon layer (see paragraph [0027]);

(c) oxidizing the nitridated conductive silicon layer (see paragraph [0027]);

(d) forming a silicon nitride layer (24) on a surface of the oxidized layer;

(e) forming a dielectric layer (26) on the silicon nitride layer; and

(f) forming a top electrode (28) on the dielectric layer.

The examiner notes that while Weimer discloses the steps of nitridating and the oxidizing essentially simultaneously with nitric oxide, the chemical mechanism is such that the nitrogen molecules react with the polysilicon and the oxygen molecules subsequently react with the nitrogen that is upon the silicon such that a silicon nitride layer is formed between the interface of the polysilicon and the oxide layer. It is clear

from the Weimer disclosure that the nitride layer is formed on the interface between the polysilicon and oxide layer, thus the polysilicon is nitridated, and the nitridated polysilicon is oxidized as required by steps (b) and (c).

More specifically, the mechanism as explained by Weimer, initially begins with nitric oxide (NO) reacting with the polysilicon to form a monolayer of nitride and oxide. As additional NO reacts with the nitridized/oxidized polysilicon, the NO must diffuse through the existing nitridized/oxidized polysilicon, as stated in Weimer. Weimer states "[t]he annealing localizes nitrogen near the interface **19** between the polysilicon layer **18** and the oxide layer **20**" and the resulting nitrogen layer at the polysilicon-oxide interface stops further oxidation. Accordingly, up until the oxidation is stopped by the nitride in this self-limiting process, the nitridized polysilicon is being oxidized which reads on the limitations in steps (b) and (c).

In re claim 2, Weimer discloses the method wherein at the step (c) a native oxide layer is used (see paragraph [0027]).

The examiner notes that the applicants have defined a native oxide to be an oxide generated wherein the substrate is exposed in an atmosphere (see specification, page 7, lines 15-23). The examiner notes that Weimer discloses the substrate exposed in an atmosphere of nitric oxide (NO).

In re claim 3, Weimer discloses the method wherein the native oxide layer is formed in a thickness ranging from about 1 angstrom to about 5 angstroms (see paragraph [0028]). The examiner notes that Weimer disclose that the nitride layer (24) is preferably about 10 angstroms, while the oxide layer (20) and the nitride layer (24)

collectively have a thickness of preferably about 15 angstroms, and thus, it can be concluded that the oxide layer has a thickness of preferably about 5 angstroms.

In re claim 6, Weimer discloses the method wherein the dielectric layer is comprised of a material having one of a high dielectric constant and being a ferroelectric substance (see paragraph [0031]).

In re claim 7, Weimer discloses the method wherein the dielectric layer is selected from a group of Ta_2O_5, Al_2O_3, HfO_2, BST, PZT, PBZT, and BLT (see paragraph [0031]).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 4-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huanga et al. (U.S. Patent No. 5,670,431).

In re claim 4 and 5, Huanga et al. disclose the invention as claimed and rejected above, including the method wherein in step (b), a thermal treatment process is carried out in an atmosphere of NH_3 gas (see column 3, lines 5-13 and column 6, lines 9-16), and wherein the silicon nitride layer is formed by using a source of dicholorosilane (DCS) in an atmosphere of NH_3 gas (see column 6, lines 31-41).

Huanga et al. do not explicitly disclose the method wherein the thermal treatment process is carried out at a pressure ranging from about 10 Torr to about 100 Torr and the silicon nitride layer is formed at a pressure ranging from about 1 Torr to about 10 Torr.

The examiner notes that Applicant does not teach that the claimed pressure ranges solve any stated problem or are for any particular purpose. Therefore, the pressure ranges lack criticality in the claimed invention and do not produce unexpected or novel results. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the thermal treatment process at a pressure ranging from about 10 Torr to about 100 Torr and forming the silicon nitride layer at a pressure ranging from about 1 Torr to about 10 Torr, since the invention would perform equally well whether the nitridating occurs at different pressures and the deposition of the silicon nitride is performed at different pressures in order to form a uniform integrate silicon nitride/silicon oxide dielectric layer that prevents oxidation of the lower electrode, (see Huanga et al., column 7, lines 25-31) and because it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller,* 105 USPQ 233, MPEP 2144.05 II A.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11

F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington,* 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-5 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 7, 13, and 14 of copending Application No. 10/318,100 (Oh et al.) in view of Huanga et al. (U.S. Patent No. 5,670,431).

In re claim 1 of instant application, Claims 7, 13 and 14 of Oh et al. recite the method for fabricating a capacitor of a semiconductor device comprising the steps of:

(a) forming a bottom electrode (see step a of claim 7);

(b) nitridating the conductive silicon layer (see step b of claim 7);

(c) oxidizing the nitridated conductive silicon layer (see claims 13-14);

(d) forming a silicon nitride layer on a surface of the oxidized layer (see step c of claim 7 and claims 13-14);

(e) forming a dielectric layer (see step d of claim 7) on the silicon nitride layer; and

(f) forming a top electrode (see step f of claim 7) on the dielectric layer.

Oh et al. does not recite the method wherein the bottom electrode is a conductive silicon layer that is formed on a substrate. Huanga et al. teaches forming the bottom

electrode on a substrate of conductive silicon layer. It would have been obvious to form the bottom electrode of Oh et al. on a substrate and with a conductive silicon material since as Huanga et al. teaches that it allows for a capacitor with high reliability, low leakage current and large cell capacitance.

In re claim 2, Oh et al. recite the method wherein at the step (c) a native oxide layer (see claims 13-14) is used.

In re claim 3, Oh et al. recite the method as claimed and rejected above, but do not recite the native oxide layer to be formed to a thickness ranging from about 1 angstrom to about 5 angstroms.

Huanga et al. disclose the method wherein the native oxide layer is formed in a thickness ranging from about 1 angstrom to about 5 angstroms (see column 6, lines 17-31). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the native oxide of Oh et al. with a thickness ranging from about 1 angstrom to about 5 angstroms, since the thickness allows for a uniform integrate silicon nitride/silicon oxide dielectric layer that prevents oxidation of the lower electrode (see Huanga et al., column 7, lines 25-31).

In re claim 4 and 5, the combined Oh et al. and Huanga et al. disclose the invention as claimed and rejected above, including the method wherein in step (b), a thermal treatment process is carried out in an atmosphere of NH_3 gas (see column 3, lines 5-13 and column 6, lines 9-16), and wherein the silicon nitride layer is formed by using a source of dichlorosilane (DCS) in an atmosphere of NH_3 gas (see column 6, lines 31-41).

Huanga et al. do not explicitly disclose the method wherein the thermal treatment process is carried out at a pressure ranging from about 10 Torr to about 100 Torr and the silicon nitride layer is formed at a pressure ranging from about 1 Torr to about 10 Torr.

The examiner notes that Applicant does not teach that the claimed pressure ranges solve any stated problem or are for any particular purpose. Therefore, the pressure ranges lack criticality in the claimed invention and do not produce unexpected or novel results. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the thermal treatment process at a pressure ranging from about 10 Torr to about 100 Torr and forming the silicon nitride layer at a pressure ranging from about 1 Torr to about 10 Torr, since the invention would perform equally well whether the nitridating occurs at different pressures and the deposition of the silicon nitride is performed at different pressures in order to form a uniform integrate silicon nitride/silicon oxide dielectric layer that prevents oxidation of the lower electrode, (see Huanga et al., column 7, lines 25-31) and because it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller,* 105 USPQ 233, MPEP 2144.05 II A.

Claims 6-7 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 7, 13, and 14 of

copending Application No. 10/318,100 (Oh et al.) in view of Huanga et al. (U.S. Patent No. 5,670,431) and Weimer (U.S. Patent Appl. 2003/0042526).

In re claims 6 and 7, Oh et al. recite and Huanga et al. disclose the method as claimed and rejected above, but do not disclose the method wherein the dielectric layer is comprised of a material having one of a high dielectric constant and being a ferroelectric substance or wherein the dielectric layer is selected from a group of Ta_2O_5, Al_2O_3, HfO_2, BST, PZT, PBZT, and BLT. Weimer discloses the method wherein the dielectric layer is comprised of a material having one of a high dielectric constant and being a ferroelectric substance or wherein the dielectric layer is selected form a group of Ta_2O_5, Al_2O_3, HfO_2, BST, PZT, PBZT, and BLT (see paragraph [0031]). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the dielectric of the combined Oh et al. and Huanga et al. of a high k material or ferroelectric as disclosed by Weimer in order to increase the capacitance of the device.

This is a provisional obviousness-type double patenting rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Kennedy whose telephone number is (571) 272-1672. The examiner can normally be reached on Mon.-Fri. 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Niebling can be reached on (571) 272-1679. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jennifer M. Kennedy
Patent Examiner
Art Unit 2812